REMARKS ON A NEW SYSTEM

OF

FORTIFICATION.

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OF

FORTIFICATION,

PROPOSED BY

M. LE COMTE DE SAXE,

IN HIS MEMOIRS ON THE ART OF WAR.

BY CHARLES THEODORE D'ASTI.

Scire tuum nihil eſt, ni te ſcire hoc ſciat alter.——Juv.

EDINBURGH:

PRINTED AT THE Apollo Preſs, BY MARTIN AND M'DOWALL,
FOR THE AUTHOR.

Anno 1787.


BRITISH MUSEUM
66
SEP

TO

HIS ROYAL HIGHNESS,

GEORGE

PRINCE OF WALES,

The Natural and Generous Patron

Of Britiſh Genius and Literature;

The following Remaks, the reſult of Speculation,

And

Love of the Art Military, rather than Experience,

Are with the greateſt ſubmiſſion,

And with the moſt profound reſpect,

Dedicated by

HIS ROYAL HIGHNESS'S

Moſt obedient

And devoted humble Servant,

CHARLES THEODORE D'ASTI.

PREFACE.

THE eagerneſs which the public have ſhown on occaſion of Mareſhal Saxe's Reveries or Memoirs on the Art of War, is a ſure teſtimony of the high eſteem which is preſerved for the illuſtrious author; and the care which has been taken to increaſe the ſeveral editions, is no leſs a proof of the goodneſs of the work. Full of views and of new ideas, he embraces all that has an affinity to the art of war; a profound ſtudy of the ancients and moderns, ſupported on experience, is remarked; and while, by knowing diſpoſitions, the Mareſhal teaches the art to conquer, which obliges often not to ſpare the life of the ſoldier, he has a particular attention to procure him all that can ſerve to preſerve his health, perſuaded that the ſucceſs of the campaign depends principally on that care. Hence all the diſcuſſions in

which he has entered, in regard of the beſt manner of cloathing the troops to make them ſubſiſt in camp, &c. contain intereſting novelties, and ſhow how great his foreſight was.

The art of fortifying places has not been forgot in this work. As the Mareſhal has brought into the examination of this ſcience the ſame ſpirit of criticiſm as in his other reſearches, it may eaſily be imagined that the imperfections which are found in the conſtruction and diſpoſition of the works have not eſcaped him; it may therefore be ſaid, that the ſyſtem of fortification has aſſumed a new ſhape in his hands: He has introduced principles hitherto unknown; he has taken off from others ſome that were at all times looked upon as very eſſential to the defence. From the combination of theſe new maxims, there reſults a method of fortifying very different from the ordinary way, that, according to his opinion ſurpaſſes it ſo much, that he is not afraid of ſaying, "That "ſuch a fortreſs would very much diſguſt the "deſire we have for ſieges." This teſtimony ought to be ſo much leſs ſuſpicious that the Mare-

ſhal does not attribute the invention of this ſyſtem to himſelf; though there is no doubt that he has contributed much to the perfection of it.

Diſcoveries that promiſe ſuch conſiderable advantages merit to be ſet in a better light than the narrow limits of the Memoirs have permitted them to be; and it is what I propoſe to do in theſe remarks: I ſhall lay down the principles of this new ſyſtem; I ſhall afterwards give a detail of the different effects that can reſult from it, and then compare the advantages and inconveniences of it; and if it happen ſometimes that I differ from the Mareſhal's opinion, it will be only when I could not hinder myſelf to give up to experience, an irrefragable judge in this matter; and the deciſions of which are ſuperior to all authority whatever.


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CONTENTS.

CHAP. I. ON the conſtruction of this ſyſtem.

CHAP. II. OF the attack and defence of the covert-way, of the lunettes, and of the counterguard.

CHAP. III. OF the attack and defence of the ravelins, and of the body of the place.

CHAP. IV. Compariſon of the advantages with the inconveniences that reſult from this ordonnance.

REMARKS ON A NEW SYSTEM OF FORTIFICATION.

CHAPTER I.

On the Conſtruction of this New Syſtem.

WHATEVER progreſs may have been made in the art of fortifying, it is far from being brought to that perfection, which the great reputation of Meſſ. Vauban and Coehorn would make us believe. The facility which the beſieger has to ruin the lines of defence of a place, and to diſmount the batteries; the difficulties which the beſieged meets, to put himſelf under cover in his works from the fire of the enemy; the impoſſibility which he finds of ſupporting the outworks, when they are ſeparated from the body of the place, by wet

ditches; all theſe are inconveniences which are but too common in modern fortification, and which is the reaſon that places, which are the beſt fortified, make a very inconſiderable reſiſtance, and not in the leaſt adequate to the expence of their conſtruction: Such are the ſentiments of Mareſhal Saxe, who demonſtrates by proofs drawn from experience. Perſuaded on another ſide, that a ſcience which has a great ſhare in the events of war, and which often decides the fate of States, is of too great importance not to deſerve his attention, he has ſought the means to correct theſe faults; and having found, upon this, his ideas conformable to the reſpectable author of whom he gives the ſyſtem, he has made no difficulty to adopt it, enriching it, at the ſame time, with ſeveral new inventions.

To remedy the firſt inconveniency, and to prevent the enemy from ruining the defences of the works, the Mareſhal has

thought proper to alter the maxims of fortification moſt generally received, and to reject the order eſtabliſhed at all times in the different heights of the profiles. Inſtead of the ordinary manner of fortifying, the works forming a kind of amphitheatre, riſing one above another as they grow diſtant from the covert-way, a diſpoſition which expoſes them altogether to the fire of the enemy; he exhauſts the body of the place no more than the outworks, and covers both by a work more raiſed, which ſurrounds them in ſuch a manner, that, with the exception of the covert-way and the foreſaid work, the beſieger can ſee nothing of the reſt of the fortification.

By this arrangement, the different kinds of outworks, ſuch as the ravelins and counterguards, form each (the ſame as the body of the place) an incloſure of itſelf, which draws its defence only from its own front, and is expoſed to the cannon of the ene-

my; but when he is maſter of that which covers it, this gives means to the beſieged always to oppoſe him, and as he advances, with new works, which till then he could not ſee, and much leſs ruin.

THE ſecond point which concerns the ſafety of the troops in the works, is now become of the greateſt conſequence, and of an execution equally difficult, on account of the numerous train with which places are attacked, and particularly on account of the *ricochet*, made uſe of to batter the interior of the works in flank, and in reverſe. To ſecure ourſelves from theſe, the Mareſhal could find no means more efficient than that of traverſes: He not only fills the covert-way, where it was cuſtomary to place ſome, but likewiſe all the terre-pleins of the outworks, and in a manner that they occupy almoſt one third of them. As they are ſolely deſigned to cover the troops, they have neither parapet nor banquette as in modern fortification, where they ſerve

at the ſame time to defend the entrance of the covert-way, which does not take place here, becauſe that its ordonnance is different from that which is now uſed.

It cannot be diſputed, that, by this diſpoſition the effect of the ricochet is much diminiſhed, for two thirds of the ſhot will plunge; yet, in that caſe, the bullets will at firſt be ſtopped in their courſe, and will not be able to do any hurt, but in a diſtance of 3 or 4 toiſes at moſt.

The faculty of communicating freely, to the different works of a place, is a quality very eſſential for their defence. This maxim has never been called in queſtion; but the practice of it hitherto has been neglected, and the communication of the outworks of places with wet ditches, meets with ſuch great difficulties as ſoon as the enemy has eſtabliſhed his batteries on the glacis of the covert-way, that one is not in

a ſituation to ſupport an aſſault, and is obliged to abandon them, as ſoon as the paſſage of the ditch is ended. This fault could not eſcape the Mareſhal's attention, the conſequence of which he had experienced; and, to correct it, he has taken a quite different road from that which the engineers have held hitherto: They had imagined, that nothing could oppoſe better, the efforts of the aſſailants, than the wet ditches, and there is not one but what has ſurrounded the outworks, as well as the body of the place with them, wherever their ſituation would permit them to do it. Mareſhal Saxe did not think ſo: He judged of the matter like an officer who knows the importance of a poſt that can be defended by a good body of men, ſupported by others in caſe of need, and even to reattack after they have been forced to abandon it, whilſt that the enemy cannot get to it, but by one opening, and through a road as embarraſſing as the paſſage of the ditch.

THE dry ditch which the Mareſhal orders between the body of the place and the outworks, procures all theſe advantages; it eſtabliſhes a ſure and eaſy communication; it ſerves as a place of arms to a great number of men, to whom the interior talus of the terre-pleins of the outworks formed *en rampe;* it furniſhes means to go to the aſſiſtance of thoſe who defend the breach; it puts them in a ſtate to diſpute the ground with the enemy foot by foot, and to oppoſe to him obſtacles ſo difficult to conquer, that the beſieged will be always ſuperior to him in number, and will have nothing to fear from his batteries.

AFTER having expoſed the motives which engaged the Mareſhal to introduce new maxims in the art of fortifying, and to change the ordonnance of the works, let us ſee in what manner he has diſpoſed them, to obtain the end which he propoſes.

HITHERTO, the engineers have always had a particular attention to the conſtruction of the body of the place: They have not only applied themſelves to the proportion of the lines, and to give as great an extent as poſſible to thoſe that are to defend the others, but they have employed all imaginable means to draw them from the ſight of the enemy, and to prevent their degradation. This is what has produced the number of ſyſtems, which is as great as there are maſters in this art: Their ideas on the manner to cover the body of the place, and keep the enemy at a diſtance, are more uniform, and are reduced almoſt to the half-moon, and to the covert-way.

MARESHAL LE COMTE DE SAXE follows oppoſite maxims: The greateſt force of his method, conſiſts in the outworks; he did not think it neceſſary to ſtick too ſcrupulouſly to the rules of art, and to obſerve all the precautions which are preſcribed.

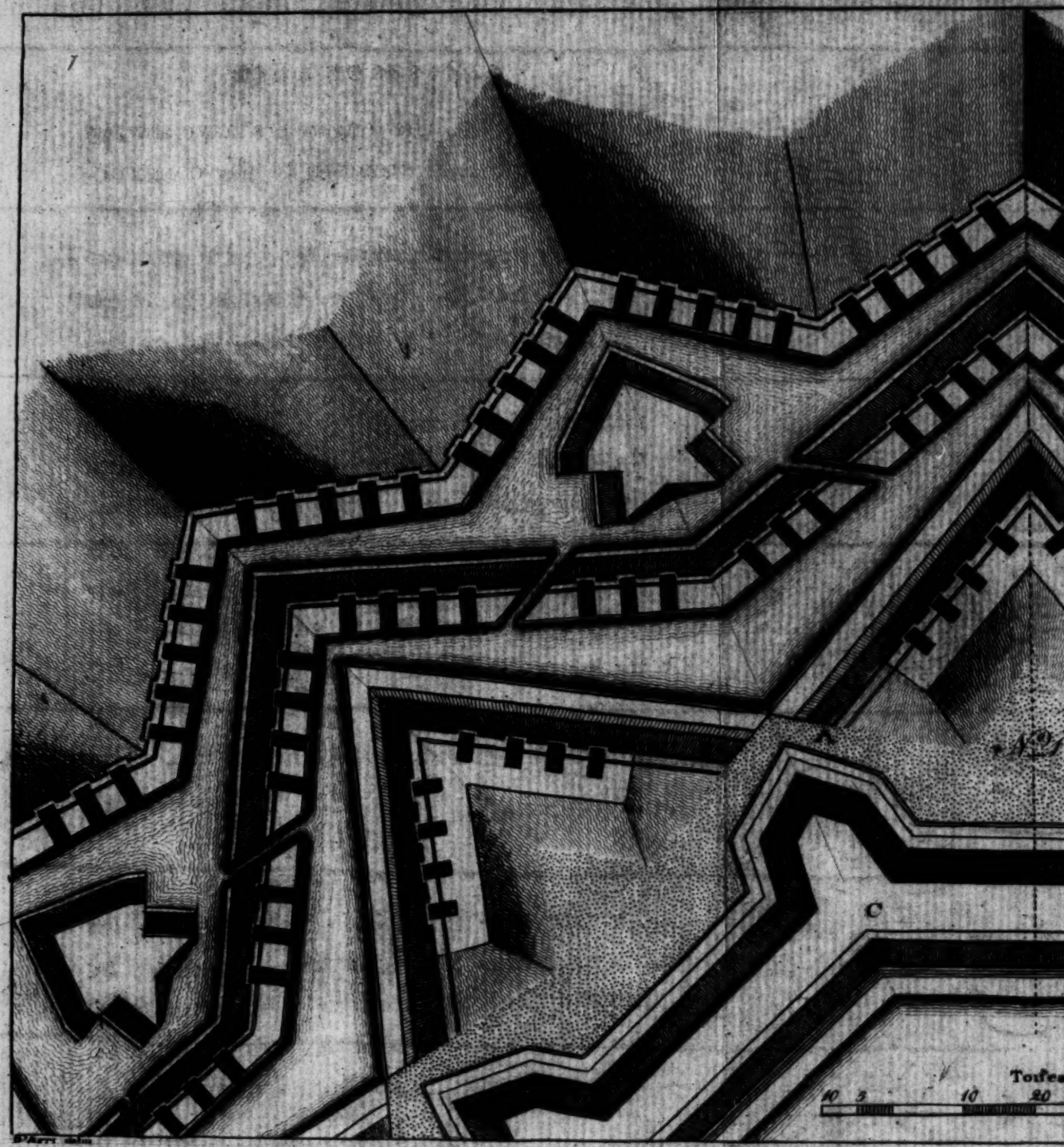
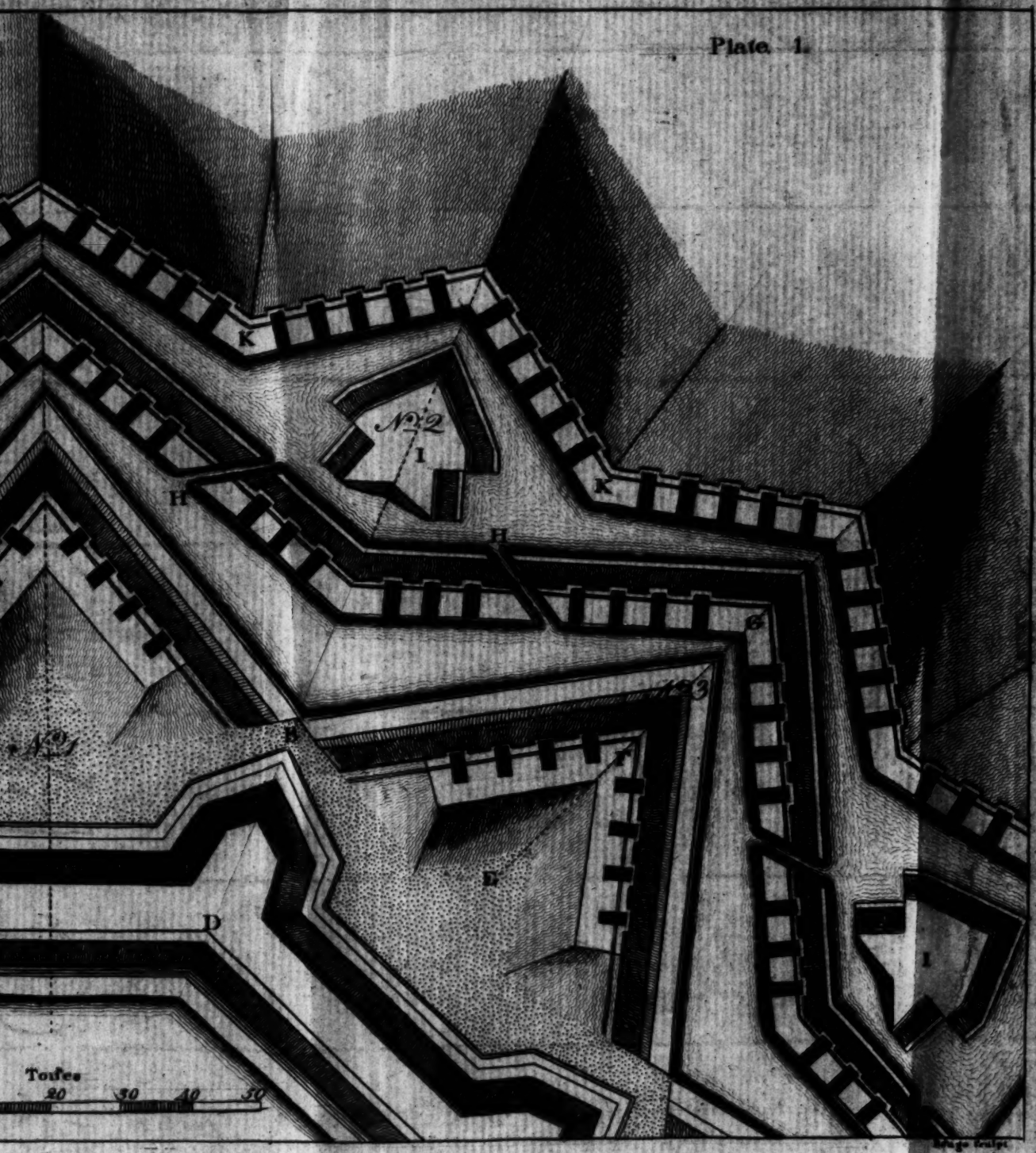

C
Toises
10 3 10 20

Plate 1.



In the octagon fig. I. which he propoſes as an example of his ſyſtem, the interior polygon AB has but 70 toiſes; the baſtions are ſmall; the flanks of a middling ſize, without brizure or orrilon, being only from 8 to 9 toiſes; the faces are but from 17 to 18 toiſes; and the gorges from 14 to 15 toiſes at moſt. The elevation of the body of the place is from 24 to 25 feet above the horizon: But what is to be remarked is, that behind its terre-plein, which is 7 toiſes wide, the Mareſhal orders a cavalier parallel to the curtain, which has a parapet with a terre-plein of 5 toiſes, and ſurrounds the whole interior of the body of the place: Its height is above 60 feet, and under it are the ſouterrains for the lodgement of the garriſon, and to ſhelter them, at the ſame time, from the fire of the enemy.

THE dry ditch which ſeparates the body of the place from the outworks, is digged even to the water or thereabouts, and is but 3 or 4 toiſes wide before the flank-

ed angle of the baſtion; it widens as it advances towards the curtain, where it forms a place of arms of an extent ſufficient to put a large body of troops in order of battle, to defend the breach and oppoſe the lodgement of the enemy in the outworks.

As the eſſential part of this ſyſtem, is to deprive the beſieger of a ſight of the works, ſo that he cannot diſcover them but ſucceſſively and as he advances with the attack, it is eaſily underſtood that the outworks muſt not, as uſual, conſiſt in detached pieces, which would not anſwer the end, but that they ought to form as many envelopes as cover every thing which is behind.

Plate 1ſt, On this principle the Mareſhal conſtructs before each polygon a work F which he calls a ravelin, and which differs from that which is commonly placed there only in its faces, which are prolong-

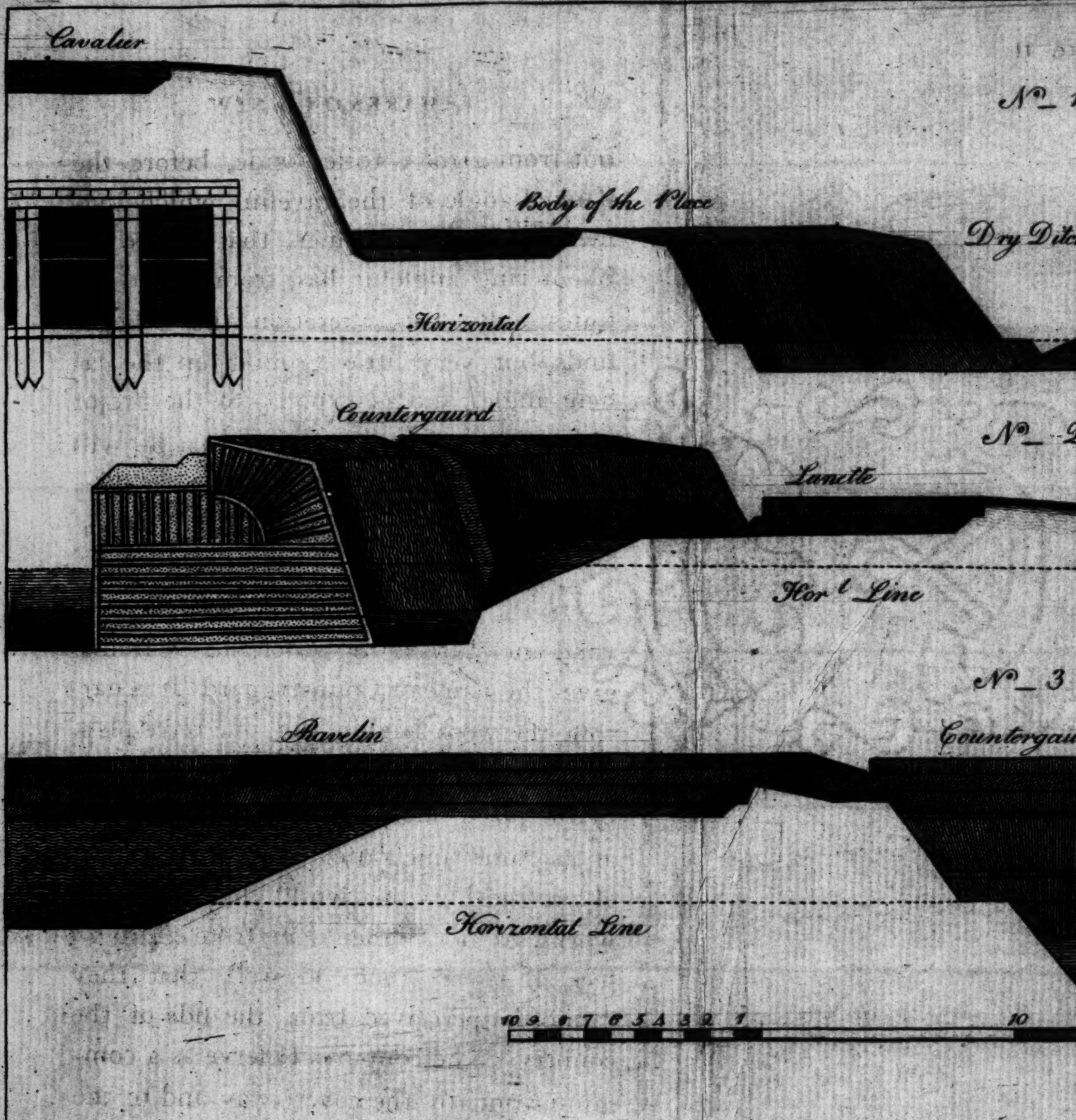
ed 4 or 5 toiſes from the flanked angle of the baſtion, where they join themſelves to thoſe of the ravelins *collateraux*, ſo that they form together a continued incloſure that leaves nothing to be perceived of the body of the place.

Plate 2d, No. I. THESE ravelins are raiſed 24 feet or thereabouts, above the level of the country, and have a terre-plein of 7 or 8 toiſes wide, furniſhed with traverſes at 4 toiſes diſtant from one another: The interior talus is conſtructed *en rampe*, for the reaſon before mentioned.

THE principal ditch which ſurrounds theſe works, is differently traced from the ordinary way: The Mareſhal having remarked, that the ditches parallel to the faces, (as is cuſtomary to make them), are liable to a great fault, which is, that the enemy, being lodged on the ſalient angle of the ditch, finds much room for the conſtruction of his batteries; he gives to his

but from 4 to 5 toiſes wide, before the flanked angle of the ravelin, which augments in ſuch a manner, that before the re-entering angle it has from 15 to 16 toiſes. By this alteration the beſieger finds but very little ground on the ſalient angle, and is expoſed to the fire of the place in ſuch a manner, that he will meet with the greateſt difficulty to make a lodgement.

On the other ſide of that ditch is a ſecond incloſure G to which the Mareſhal gives the name of Counterguard: It is narrow, the work having but one terre-plein of 3 or 4 toiſes, and ſurrounds the body of the place and the ravelins; and being at the ſame time raiſed more than 30 feet above the horizon, whilſt that the other works are not higher than from 24 to 25 feet, it covers them ſo well, that they cannot be perceived from the ſide of the country. The coupures H ſerve as a communication to the covert-way and to the



Cavalier
N°_1
Body of the Place
Dry Ditc
Horizontal
Countergaurd
N°_2
Lanette
Horl Line
N°_3
Ravelin
Countergau
Horizontal Line
10 9 8 7 6 5 4 3 2 1
10

D'Arcy delin

Plate. 11.

№ 1

ry Ditch

Ravelin

Line

№ 2

Covert Way

№ 3

ntergaurd

Covert Way

10 20 30 Toises

Bougo Sculpt

lunettes: The terre-plein of that work is likewiſe furniſhed with traverſes at the diſtance of 4 toiſes from each other.

Plate 2*d*, No. III. UNDER the rampart of the flanked angle of this work, there are caſemates; often on the ſide of the ditch of the ravelins. They ſerve as a retreat to the batteries *a radeaux*, (the invention of the Mareſhal, ſeen in the 22d plate of his Memoirs), which defends not only that ditch, but likewiſe that of the counterguard and of the lunettes, by making them paſs by the coupures above mentioned.

THE conſtruction of the counterguard is of an entire new invention, or rather an imitation of the ancient manner of building them by the Gauls, as deſcribed by Julius Ceaſar in his Commentaries: They are a bay of joiſts, the beams of which are diſtant from 4 to 5 feet acroſs the whole length of the work: (plate 2d, No. II. and III.) After they have been covered to a

certain height with earth, they place a ſecond bay of joiſts, which is likewiſe covered with earth, and ſo on, to the top of the work. The Mareſhal's manner differs from the ancient in this, that he conſtructs the exterior ſide in talus and of turf only; in place of which the Gauls raiſed it perpendicular, and filled the interſtices between the heads of the beams with large ſtones. The ditch which ſeparates this incloſure from the covert-way, is conſtructed like that of the ravelins, and is but 4 toiſes wide before the ſalient angles.

THE lunettes I ſerve to cover the reentering angle of the counterguard, and to defend its ditch before the ſalient angle. One-third of their faces are retired within, and holds place of flank: The height of theſe works is not determined; but it appears that they can ſcarcely be raiſed higher than the covert-way: They are ſepara-

ted from the counterguard by a ditch of 3 toiſes only.

THE covert-way K is 5 toiſes wide: It has neither retrenchment nor place of arms in the re-entering angles; but it is filled with traverſes, of which there are 5 on each branch, and 4 toiſes from each other: Its parapet is formed *en glacis*, which loſes itſelf as uſual in the country.

IT is this which conſtitutes the new ſyſtem entirely different from any thing hitherto imagined in point of fortification. The queſtion is now to know, whether the method propoſed puts the beſieged into a ſtate to make a better reſiſtance without expoſing himſelf to new inconveniences, which, although of a different nature, may be no leſs troubleſome than thoſe which we wiſh to avoid.

CHAPTER II.

On the Attack and Defence of the Covert-way, of the Lunettes, and of the Counterguard.

HAVING ſeen the new maxims which the Mareſhal eſtabliſhes in the art of fortifying, and the application which he has made of them in the conſtruction of the different works; let us now examine the effects that may reſult, and the advantages that the defence may receive from them.

As from one ſide, the beſieger cannot at firſt diſcover any thing of the works of a place, which the covert-way and firſt incloſure formed by the counterguard conceals; the beſieged, on the other ſide, cannot diſpute him the approaches and the conſtruction of his batteries, but with his cannon in the covert-way.

We have hitherto known but two ways of proceeding in this work; the one to make elevations of earth in the ſalient angles to fire *en barbette*, and the other to draw back the cannon towards the ditch, ſo that being reſted on the *ſemelle*, the ſhot paſſes above the paliſade: This method is very uncertain, and of little effect, becauſe we do not ſee the object, and conſequently fire always at random; the other is very dangerous, becauſe the cannon, as well as thoſe who ſerve them, are expoſed to the ſight of the enemy, ſo that we can only uſe it in the night.

Of theſe two methods Mareſhal Saxe has compoſed a third, which unites the advantages, and corrects the inconveniences of the one and of the other. In place of thoſe elevations of earth, he conſtructs ſcaffolds ſolid enough to ſupport the weight of cannon, and to reſiſt the effect of the repercuſſion: They are raiſed about 6 feet above the covert-way, and at 2½ feet

from the ſummit of the parapet; their length is 24 feet, of which the platform takes 10 feet, the reſt goes in a ſlope which terminates at 7 or 8 feet from the border of the ditch. The cannon that are made uſe of on theſe batteries are mounted on navy carriages; when they are fired, their recoil makes them ſlide down as far into the covert-way, where they are loaded again, ſheltered from the enemy's fire; they are drawn up afterwards by a machine, which is not well enough expreſſed, to form a juſt idea of it*.

WITH theſe batteries, the Mareſhal propoſes to ruin thoſe of the beſiegers in the day time, and to fire with grape ſhot on the front of the trench during night. As this idea is entirely new, it deſerves to be examined: During the time when the cannon is on the top of the platform, it is expoſed to the ſight of the enemy, as well as

* See plate 23d. of the Memoirs.

the canoneer who is to ſet fire to it, and conſequently it is attended with much danger, to take the neceſſary time to point the pieces, as ſoon as the trench is advanced within muſket-ſhot: Beſides, theſe pieces cannot be of much more than ſix lb. weight ball; for without ſpeaking of the effects which the ſcaffolds and the cordages would have to ſupport, and ſtop the cannon at the bottom of the deſcent, and to which they could not reſiſt at length, two or three men, which the Mareſhal employs only, for the ſervice of each piece, could not fire it on the platform if it were of a heavier ball, unleſs the machine we have been ſpeaking of were ſtrongly built, which would diminiſh on another ſide the vivacity of the fire, and expoſe the cannon more, which muſt alſo be mounted ſlower. It will, therefore, not be poſſible to fire with the required juſtneſs, and it will be much leſs ſo to ruin the batteries of the enemy with a ball of that ſize. The firſt of theſe difficulties is met with in the em-

ployment of the *amuſettes*, a kind of culverin of half a pound ball, of the Mareſhal's invention, (and ſeen in the 5th plate of his Memoirs), which he makes uſe of inſtead of muſketry, and which he mixes with the large cannon: We can then neither flatter ourſelves to fire continually into the embrazures of the enemy's batteries, nor to prevent him from making uſe of his cannon, as is mentioned in page 146 of the Mareſhal's Memoirs, becauſe it requires as much leiſure as ſkill.

If theſe remarks are well founded, it is certain that the beſieged cannot diſpute much the approaches and conſtruction of the beſieger's batteries, by the cannon of of the covert-way. This is, however, the only place where he can put any, for the terre-plein of the counterguard is not proper for it, on account of its little breadth; and its great elevation forms a ſecond obſtacle, becauſe the cannon cannot be tranſported into it, but by a machine which

could not fail of being attended with many difficulties in the execution. It is yet to be remarked, that, ſuppoſing the effect of theſe batteries to be ſuch as the Mareſhal would have them, the beſieger could be no longer incommoded by them, as ſoon as he arrives at the foot of the glacis of the ſalient angles; the branches of the covert-way look too obliquely at one another, and the cannon as well as the *amuſettes* can fire only ſtraight before them, unleſs their direction is changed at the top of the platform, which, from the reaſons above mentioned, would prove very difficult. There remain no other means then, to the beſieged to oppoſe the enemy, but by ſorties.

THIS reſource, which the engineers have always conducted with caution, appears to be entirely neglected by the Mareſhal. There are no places of arms in the re-entering angles, where one could aſſemble troops for expeditions of that

kind: Moreover, the traverſes, as well as the batteries conſtructed in the covert-way, hinders the communication between its different branches; and if, notwithſtanding, in ſpite of theſe obſtacles, one could ſucceed in making ſorties, the troops would find much difficulty in the retreat; becauſe they cannot be protected, but by the muſketry of the counterguard, too much raiſed, and too far diſtant in ſome places, to do it with ſucceſs.

THE approaches being puſhed as far as the foot of the glacis, the beſieger will be at liberty to attack the covert-way, either by ſap or main force, to which the new ordonnance gives greater facility: For, after he has cleared the creſt of the glacis with his cannon, and broken the paliſadoes, nothing will hinder him from advancing to the platforms, and from throwing into the ditch every thing that is found between the traverſes, which conſiſts only of a few men who ſerve the cannon, becauſe there

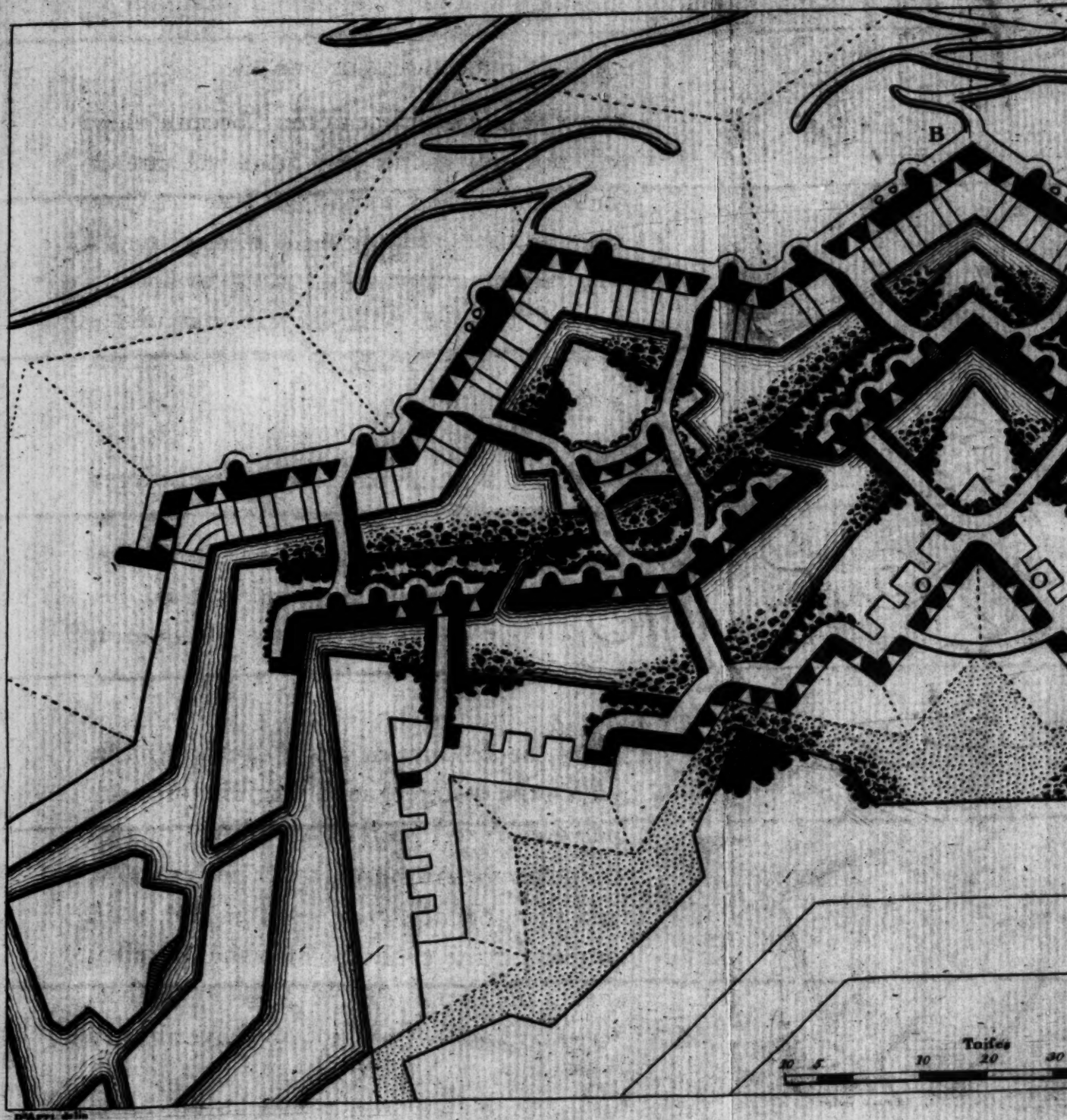
is not ſpace enough to poſt any other troops; beſides, the traverſes being continued as far as the border of the ditch, cuts off the communication, and takes from them all means of ſupporting one another. This occaſions, that ſurpriſes are no leſs to be feared than the *coups de main*; ſo that the enemy, by the one or the other means, might render himſelf maſter of it without any other formality.

In caſe the attack by ſap is preferred, the beſieger will employ the cavaliers of the trench A plate 3d. to lodge himſelf on the ſalient angles B. He will afterwards continue his lodgement along the paliſade, and drive the enemy from the covert-way without much trouble, becauſe there is no retrenchment in the re-entering angles, and he will not dare to ſhew himſelf any longer on his batteries. The lodgement being ended, he will pierce the parapet, and enter into the covert-way by any ſide he ſhall think proper, to which the traverſes will

prove of great ſervice to him, becauſe they will not only ſhelter him from the fire of the counterguard and of the lunettes, but likewiſe hinder the beſieged from going to him and interrupting his work by ſorties, ſo the beſieged will not have it in his power to drive him from it, as ſoon as his poſt is eſtabliſhed.

MASTER of the cover-way, the beſieger will conſtruct the batteries C to open the faces of the lunettes D, which he muſt carry before he attacks the counterguard, becauſe their flanks defend the ditch of it, before the ſalient angles.

As the re-entering angle of the tenaille which the counterguard forms before each polygon, is too open for enabling the two branches to flank each other reciprocally, and that, beſides, this work is not at all proper for the cannon which the Mareſhal makes uſe of for the purpoſe of the batteries *a radeaux*, of which we have already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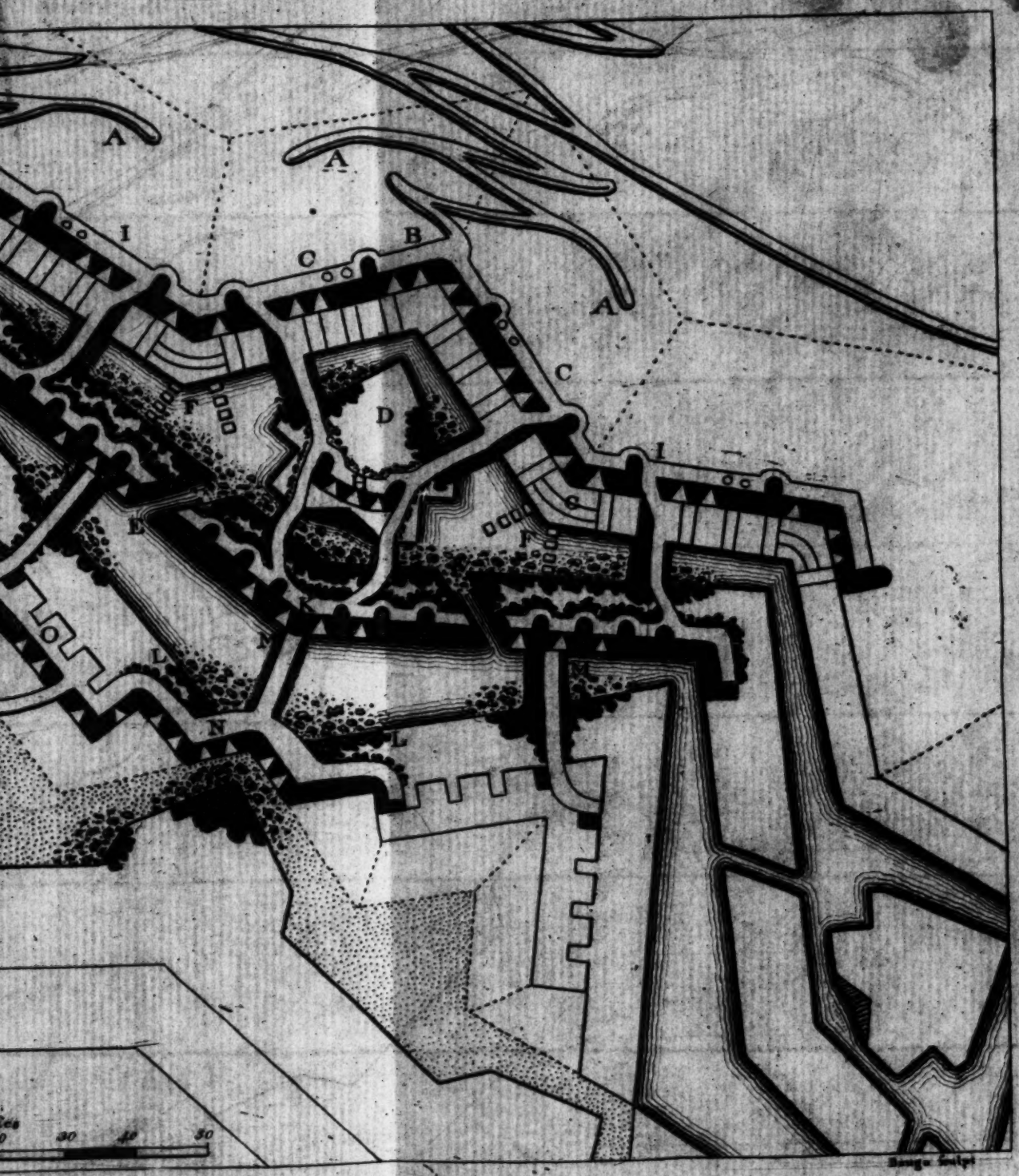
A
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ſpoken, and from which he promiſes himſelf great advantages for the defence*.

Viz. "SUPPOSING the enemy to attack "me, he carries off my covert-way as "uſual, ruins the defences of my lu-"nettes; as long as I have my caſemates "free in the re-entering angles of my "counterguards, How will he paſs the "ditch to go to my counterguard and to "my lunettes? The anſwer is, he will "ruin them. That is not ſo eaſy, if I do "not ſay impoſſible, for he cannot place "above three pieces of cannon on the ſa-"lient angle of the counterſcarp; and in "approaching my radeaux from my caſe-"mates, I make a continual fire of 100 "pieces of cannon, which will take them "from top to bottom. And, provided I "have one foot of day, I ſhall always ſee "with 100 pieces of cannon into the bot-"tom of the ditch of the ſalient angles of

* Page 44 of the Memoirs.

" my counterguard and of my lunettes, Will
" he then dare to make his gallery expoſed
" night and day to ſo terrible a fire, which
" he can neither ſee nor diſmount?"

To know now, whether the new invention will anſwer to the idea which the Mareſhal has given us: We muſt firſt remember, that the caſemates for the batteries *a radeaux* are conſtructed under the terre-plein of the ſalient angles of the counterguard, and that they have their ſortie into the ditch of the ravelins, ſo that the radeaux ought to enter into the ditch of the counterguard by the coupures E, and to range themſelves afterwards in ſuch a manner as to flank the ſalient angles of that work and of the lunettes. By this, it is eaſy to ſee, that one can never employ in it 100 pieces of cannon, each of which is mounted on a radeaux of about 2 toiſes in ſquare, unleſs one was to cover the ditch entirely with them; but in that caſe, it will be impoſſible to ſee with them

into the bottom of the ditch of the ſalient angles of the counterguard and of the lunettes, as we pretend to do. Every thing well reckoned, it is not poſſible to place above 16 of theſe radeaux on each polygon, which, coming out of the coupures E, ought to range themſelves about, after the manner which is marked in F, plate 3d, to flank the ſalient angles of theſe works, and to defend the paſſage of the ditches. This is what is reduced to, as far as we can judge, that terrible battery of 100 fire mouths.

It will yet be neceſſary to examine, whether the beſieger cannot render the uſe of theſe radeaux entirely uſeleſs: The coupures E by which they ſhould paſs into the exterior ditch, have but 3 toiſes in width; the height of the counterguard is about 40 feet, reckoning from the ſurface of the water: By raiſing batteries in the re-entering angles of the glacis, it will be eaſy to batter the counterguard on one

ſide and the other of the coupure, and the rubbiſh, conſidering the height of the work, will embarraſs the narrow paſſage in ſuch a manner, that no radeaux will be able to get out; and ſuppoſe even that it ſhould find means to do it, a detachment of infantry placed in the lodgement of the re-entering angle C I, will receive them with muſket-ſhot coming out of the coupure, and hinder them from ranging themſelves oppoſite to the ſalient angles; becauſe it requires much time, and cannot be done but under a very briſk fire: That the radeaux of the other polygons may not render themſelves *poiſcent* on the front of attack, the beſieger needs but to eſtabliſh ſuch poſts in the ſalient angles, where the lodgement is found ready formed by the traverſes.

It will eaſily be judged from this detail, that the paſſage of the ditch of the lunettes cannot be much diſputed; and as it is but from 7 to 8 toiſes wide at the place

where the beſieger muſt conſtruct the bridge, he will end it in a ſhort time, and there will be no other reſource to the beſieged, but to abandon theſe works, unleſs he chuſes to expoſe himſelf to be cut in pieces, having no other retreat but by the aforeſaid coupures, and conſequently very dangerous.

THE beſiegers will conſtruct the batteries H in theſe lunettes, which the beſieged cannot oppoſe, but by the muſketry of the counterguard, too much raiſed to do it with any ſucceſs. Theſe batteries being finiſhed, the re-entering angle of the counterguard will ſoon be opened: The ditch, which in that place is but 4 toiſes, will be filled by the tumblings, and the paſſage formed without the beſieger having occaſion to make uſe of a ſingle faſcine.

DURING this time, the ſalient angle of the counterguard will be beat by the batteries I; and as the beſieged finds himſelf

here in the ſame impoſſibility of defending the paſſage already half formed from the tumblings, on account of the narrowneſs of the ditch it will ſoon be perfect, and the lodgement eſtabliſhed at the foot of the breach, without the town's being able to oppoſe it in the leaſt.

THINGS being arrived ſo far, there is no doubt but the beſieged will be forced to abandon the counterguard, becauſe it is impoſſible he can maintain himſelf in it in caſe of an attack, conſidering the narrowneſs of the work, embarraſſed by the traverſes; and on another ſide its elevation renders the retreat extremely difficult, becauſe it cannot be made but by ſtairs, commonly in the terre-plein, which might eaſily be ruined by mines, and would conſequently take from the beſieged all means of making his retreat, if he delayed it in the leaſt.

THIS is all that the beſieger ought to put in practice to render himſelf maſter of the covert-way, the lunettes, and the counterguard. In the following chapter, I ſhall treat of the ulterior operations of the ſiege, until the taking of the place.

CHAPTER III.

Of the Attack and Defence of the Ravelins, and of the Body of the Place.

BEFORE I ſpeak of the lodgement, and of the batteries of the beſieger on the counterguard, it will be neceſſary to examine what method ſhould be followed in the conſtruction of that work. I have ſeen what the Mareſhal propoſes on this ſubject; but as the project which he gives is not formed to be executed in haſte, and in a country full of foreſts ſuch as Poland, it is to be believed on all other occaſions where the queſtion is to conſtruct places not to conquer a place, but to preſerve and defend it, he would employ more ſolid and more durable materials than wood, which participating of all the variations of the weather, be it expoſed to the air or covered with earth, cannot be laſting, par-

ticularly what regards the caſemates; becauſe it is impoſſible that ſingle beams planted in the ditch, without ſome other precautions, can long ſupport ſo great a quantity of earth as that with which they are loaded, without ſpeaking of the damp which deſtroys them in a few years.

As it appears, from what has been mentioned above, that nothing can be done without maſonry in this conſtruction, there remains to enquire, Whether the method given in page 149 of the Memoirs of the Mareſhal, is preferable to the common method of terraſſing and facing the works. *Anſ.* " Such forts are only practicable where " wood is plenty: But one might conſtruct " ſome without wood on the ſame ſyſtem, " obſerving, nevertheleſs, that the coun- " terguard be made in ſuch a man- " ner, that the enemy cannot lodge him- " ſelf in it; a good brick wall behind, " which I would recommend, and the

" raiſing of ſome ſcaffolds, might be ſuffi-
" cient for a counterguard."

THERE is yet another idea to conſtruct this work: For, to form a true knowledge of it, it would be neceſſary to have a detailed draft of theſe ſcaffolds, which ſhould be kept in the magazines, and raiſed but at the time threatened with a ſiege; without this, they would be difficult to keep long, and their expence would become very conſiderable; it would, moreover, be neceſſary to know how to preſerve them from fire-works, which the beſieger will not fail to make uſe of to deſtroy them.

BUT let us ſuppoſe, that all this were to meet with no difficulty, there is yet another reflection to be made on that conſtruction: The parapet to cover the troops employed on that work, is formed only by the aforeſaid wall, raiſed about 15 feet above the creſt of the glacis, without being terraſſed. It is known, on one ſide, how fa-

tal a parapet of this nature is to thoſe whom it ſhould guard from the fire of the enemy; and on the other, it will clearly be underſtood how eaſy it will be for the beſieger to ruin it with his batteries eſtabliſhed in the country; ſo that from it we cannot promiſe the leaſt ſervice for the defence of the covert-way. The beſieger having afterwards eſtabliſhed himſelf on the glacis, will tumble down the wall into the ditch, and as the ground of the counterguard is now level with the horizon, he will be entirely covered in it from the cannon of the ravelins, too high to diſcover from their terre-plein what paſſes in it, and nothing can prevent him from eſtabliſhing his batteries in it, and from ruining theſe works which he can ſee to the foot of, and from which he is only diſtant a few toiſes.

To avoid all theſe inconveniences which muſt inevitably ariſe from the one and other of theſe conſtructions, the beſt will

be to keep by that which is now uſed; that is to ſay, to face and terraſs the counterguard as uſual. Being eſtabliſhed on the foot of the breach, as is mentioned in the end of the preceding chapter, he muſt work to the ramps to attain the top of the work, and conſtruct his lodgement all along the exterior lining, torn by the cannon from the covert-way, where he can neither be ſeen nor moleſted, and that becauſe the counterguard is more raiſed than the ravelins and the body of the place. One may judge from this with what eaſe he will eſtabliſh himſelf in it; for he has only to throw himſelf between the traverſes at 3 or 4 toiſes from the exterior ditch, and the parapet of his lodgement will find itſelf ready formed. This will be done, particularly on the re-entering angles, without the leaſt hinderance; becauſe that part of the faces of the ravelins which is oppoſed to them, and which ſhould defend them, has but a ſingle parapet without a terre-plein, ſo that one cannot place even

ſome infantry in it: There remains, therefore, only the middle of that lodgement which can be beat by the cannon of the ravelins; but as it is *en barbette*, and thoſe who ſerve it are uncovered, ſome platoons of infantry placed over againſt theſe batteries will prevent it, and make them abſolutely quit the rampart, becauſe they command it from the elevation of their lodgement.

THE beſieger will afterwards ruin the caſemates by the mines under the ſalient angles of the counterguard, and by that means cut off the retreat to the batteries *a radeaux*; which, after that, will not be able to hold out in the ditch, expoſed as they are on all ſides to the grenades and other artifices of the beſieger, without it being poſſible to free them from it, and prevent them from being burnt.

THE batteries K on the counterguard being in order, the beſieger will beat in

breach the re-entering angles of the ravelins L; and as the extremity of their faces at the place where they join one another, and form the dry ditch before the baſtion, has no other thickneſs than that of the parapet, they will ſoon be beat down by the cannon, and ſhew a full view of the flanked angle, and the faces of the baſtion; which the beſieger may afterwards ruin with the ſame battery, and enfilade the flanks in ſuch a manner as to render them entirely uſeleſs for the defence of the dry ditch.

THE counterguard being too much raiſed, and too narrow to deſcend from its terre-plein into the ditch, the beſieger will be obliged to pierce that work even with the water, and to conſtruct ſome galleries, in order to open a way into the ditch, as well before the ſalient, as the re-entering angles of the ravelins M, where he wants to make his paſſage. As all theſe places are abſolutely under cover from the fire of

the place, becauſe the beſieged cannot ſee them in front on account of the height of the ravelins, and he cannot beat them in flank for want of a terre-plein to the re-entering angles of theſe works, the ditches will be filled, and the bridges finiſhed in a ſhort time without any obſtacle. The beſieger will afterwards widen the breach at the re-entering angles with cannon-ſhot or by the mine, and conſtruct the lodgement N on the ſalient angle of the dry ditch, which the beſieged can oppoſe only from the fire of the flanks: But as they are ſo ſmall that not above two or three pieces of cannon can be placed in them, and beſides, thoſe of the attacked baſtions are enfiladed by the batteries of the re-entering angles of the counterguard, as has been mentioned above, it is not to be feared, that, by their means, they can hinder the beſiegers from completing that lodgement, and from maintaining it.

To render the breach of the ſalient angles of the ravelins practicable, the beſieger will be obliged to attach the miner to it, on account that the height and the proximity of the counterguard hinders the cannon placed on its terre-plein, to plunge as much as would be neceſſary.

The lodgements being eſtabliſhed at the foot of the ravelins, the beſieger muſt employ the bombs and the ſtones to diſquiet the troops poſted in the dry ditch, and deſtined to ſuſtain thoſe who defend the breach; in which the lodgement of the counterguard will be of great ſervice to him, becauſe it ſurrounds the ravelin and commands it: And as that which is before the point of the baſtion, marked N, takes them ſtill in flank, and by its means the beſieger may enter the ditch, and charge them at the ſame time he gives the aſſault to the ſalient angles, it is impoſſible that they can ſupport themſelves at the foot of the rampart; and in that caſe the retreat

will become ſo much more difficult, that it can be made by no other way than by the poſtern to the middle of the curtain, entirely uncovered, and without any protection on account of the height of the body of the place.

THE beſieged having been obliged to abandon the dry ditch, will find no means to re-enter and diſturb the beſieger's works, becauſe the openings from the poſtern become impracticable to the ſight of the enemy, and becauſe the communication with the other polygons is cut off by the lodgements before the baſtions; ſo that it is but from the fire of cuſtom that he can oppoſe himſelf to the conſtruction of the ravelins. We may eaſily ſee, that this will not ſuffice to bring any obſtacles to it, and that nothing will prevent the beſieger from eſtabliſhing the communication of the ſalient angle with the re-entering angles, and afterwards to conſtruct the

batteries O to ruin the flanks, and open the faces of the baſtions, already much degraded from the cannon of the counter-guard.

As all the lines of the body of the place are of little extent, and entirely expoſed to the ſight of the enemy lodged in the ravelin, they will ſoon be put out of defence, becauſe the baſtions are ſo narrow, that the bombs muſt in a ſhort time diſmount the cannon, and turn out the troops who ſhould attempt to defend the breach; ſo that the garriſon being attacked in its laſt refuge, will be forced to capitulate: For, though the cavalier ſurrounds the whole place, it will not be able to anſwer the end of a retrenchment, being raiſed to ſuch an exceſſive height; but to procure to the beſieged the faculty of ſeeing into the country, and to obſerve what paſſes in the lodgements of the enemy; a very eſſential thing to precaution ourſelves againſt

their attacks, and which, without that, would be abſolutely interdicted to him, whenever he is obliged to abandon the counterguard.

CHAPTER IV.

Compariſon of the Advantages with the Inconveniences that reſult from this Ordonnance.

By what has been ſaid of the attack and defence of this new ſyſtem, it will have been perceived, that if it remedies on one ſide the faults of modern fortification, it is not exempted on the other from ſeveral inconveniences which grow from its own corrections, and which render them often uſeleſs. To know, therefore, on which ſide the advantage lies, let us gather under the ſame point of view the different effects that can reſult from them; let us compare one with the other, and then venture ſome reflections on the changes to be made in the ordonnance of the works to render them capable of a greater reſiſtance.

ALL the engineers have hitherto agreed, that the covert-way cannot be without muſketry, and that for two reaſons: The firſt, Becauſe that its conſtruction expoſes it to the attack of main force as ſoon as the beſieger has attained to the foot of the glacis, and that the beſieged cannot oppoſe it, but by detachments which ought to be at hand, and diſpoſed in ſuch a manner as to be able to ſupport thoſe of the ſalient angles; without this precaution, the enemy will eaſily fix their poſt before the ſuccours ſent from the other works have arrived, becauſe they are moſtly obliged to go over bridges or in boats, which require a deal of time: The ſecond reaſon is, That the retreat of the ſorties can be aſſured only from the infantry of the covert-way, without which it would be eaſy for the enemy to enter it with the troops which he has juſt repulſed, and render himſelf maſter of it before he could be ſtopped. Surpriſes would be no leſs to be

feared in that caſe, and might eaſily bring forth the ruin of that work.

ACCORDING to this argument, the covert-way of modern fortification is appropriated only for the infantry; but experience has afterwards ſhewn us, that cannon are of great ſervice in it, for interrupting the enemy's works and ruining their batteries; they have been employed with ſucceſs, although in ſo imperfect a manner, that they cannot be made uſe of but in the night, as has been already mentioned.

MARESHAL SAXE having on the other ſide conſidered the advantage that cannon in the covert-way can produce, without reflecting on the ſervice which the infantry is alone capable to render in the above-mentioned caſe, is of opinion, "That the cuſtom "of placing many troops in it, and mak- "ing a great fire of muſketry, is not good, "becauſe they are harraſſed, and that the "fire on the workmen in the dark is but

" a noiſe; that batteries *en barbette* are " much better; that this fire will be much " more deſtructive than that of muſketry, " becauſe it pierces gabions and faſcines; " that the bullets would continually ſweep " the whole breadth of the trench, bound " and rebound far beyond their reach; in " ſhort, that 12 pieces thus diſpoſed, would " do more miſchief than 1000 men that " would have paſſed the night in this " work."

CONFORMABLE to this idea, the covert-way in this new ſyſtem is ſolely appropriated to the uſe of cannon, without there being any means of placing infantry in it, as has been remarked in the 2d chapter, where it is to be obſerved, that for that reaſon it is expoſed to ſurpriſes, ſubject to be inſulted, and by no means proper for ſorties; beſides, from the nature of the batteries, the effect of the cannon can be but very uncertain; to which it muſt yet be added, that the ſcaffolds being raiſed ſo

as to prevent the traverſes from exceeding them more than 2 feet or thereabouts, which is not ſufficient to ſecure them from the ricochet, and that being ruined by the bombs, which the beſieger will not fail to make uſe of on this occaſion, the beſieged will find much difficulty in repairing them, being confined in ſuch in a manner that there is no going to them but by the ditch, a thing already become very difficult in a ſituation like this, where the level of the water is 12 feet lower than the covert-way, and altogether impoſſible when that elevation is greater, particularly on account of the tranſporting of cannon and their materials, unleſs one was to alter the counterſcarp *en rampe*, which, on the other hand, would not be without its inconveniences, as one may eaſily judge.

Of all theſe conſiderations, it naturally reſults, that the good of the defence requires to conſtruct the covert-way in a manner to be able to employ cannon as

well as muſketry without difficulty; and as it is no leſs proved from experience, that all works in fortification which want either the one or the other of theſe arms is imperfect and cannot effectually reſiſt the efforts of the attack, there is no room to except the covert-way from that rule; particularly, as on one ſide we cannot promiſe ourſelves any advantage from our glacis, the only obſtacle which oppoſes the uſe of cannon, that a ſimple parapet, with a ditch on the ſide of the country, cannot equally procure; and, on the other, there are ſeveral which cannot be obtained but by that conſtruction; ſuch as the ſafety againſt ſurpriſes, the means of making ſorties with more ſucceſs, and the facility of ſupporting better than uſual the ſmall works erected in the country to oppoſe the enemy's approaches.

As the traverſes in the Mareſhal's ſyſtem do not alter their nature, but, on the contrary, cauſe more trouble as their num-

ber increaſes, it appears that it would be much better to ſuppreſs them entirely, as ſome engineers of reputation have already done, and rather expoſe the troops to the ricochet, than procure to the enemy, by their means, the facility of lodging and maintaining himſelf in the covert-way. It is further to be obſerved on this ſubject, that in the parapet conſtruction of which I have ſpoke, the ricochet is leſs to be feared than in that of the glacis: As we are not expoſed in them to unforeſeen attacks, and the defence of the country does not depend on the muſketry alone, the troops do not need to be perpetually bordering the covert-way, but will keep in the intrenchments eſtabliſhed in the re-entering angles during the time the cannon from the ſalient angles loaded with grape ſhot will fire on the trench, and defend the border of the ditch of the counterſcarp.

The idea of covering the body of the place and the outworks, ſo as to prevent their being ſeen from the country is entirely

new; the endeavour hitherto has been to deprive the enemy, by advanced works, only of the ſight of the wall of the body of the place, and to prevent by their elevation, that they ſhould not diſcover the defences as much as is neceſſary to ruin them. On which the Mareſhal obſerves, that though the beſieger cannot ruin the defences, he will prevent the beſieged from making uſe of them; to which, on another ſide, the elevation of the body of the place cannot procure the power to fire on the glacis while there are people on the advanced works; and that, therefore, it is to no purpoſe that the body of the place ſhould have a view from above the works on the glacis, while it can ſerve but to defend thoſe which are directly before him.

FROM all this it may be concluded, that it would be better "if the defences were "lower on the ſide of the body of the "place; becauſe that for to ruin them, the "enemy would be obliged to tranſport

" ſome cannon on each work, one after the
" other, which would not be eaſy; particu-
" larly if the works were conſtructed in
" ſuch a manner, ſo as to have no ground
" on the one ſide, and much on the others,
" and that they could be re-attacked be-
" fore the enemy had completed his lodge-
" ment."

HOWEVER ſpecious this new theory may appear, it meets, notwithſtanding, with many difficulties in the execution, as is ſhown in the preceding chapter, and which I mean to prove yet more in this. The principal advantage of this ordonnance conſiſts in this, that the body of the place and the ravelins are not expoſed to the ſight nor to the cannon of the enemy, but ſucceſſively, and that a work cannot be ruined but by batteries eſtabliſhed on that which is immediately before it.

THE inconvenience which reſults from this diſpoſition is, that each work can be

defended only by itſelf, without the others being able to contribute to it in any degree, which proves a great defect, particularly in this ſyſtem; and this is why the different incloſures formed by the counterguard and the ravelins, and deſtined to cover the body of the place, only compoſe that of the tenailles, a kind of work which is very imperfect in point of fortification, becauſe all its defences are ſeen in front, and may be ruined by one ſingle battery eſtabliſhed in the middle of the line. This imperfection increaſes ſtill in proportion as the flanked angle of the tenailles is more open; ſo that in the given project, where the branches of the counterguard form, in their meeting, an angle of 140 degrees, it is impoſſible that they can flank one another, and there remains to them only the front defence, which, on account of the height of the work, cannot prevent the paſſage of the ditch, as has been demonſtrated in the preceding chapter.

ALL this ſeems to prove, that it is better to oppoſe to the enemy ſeveral works at once, capable of ſupporting one another mutually, than to preſent them to him one after the other, reduce each to its proper defence, particularly when attention is given to cover the body of the place in the moſt eſſential parts; ſuch as the faces, to ſecure the foot of the revêtement, and to diminiſh the height of the lines that are moſt expoſed to the fire of the enemy.

As the intention has likewiſe been in the conſtruction of the counterguard, to deprive the enemy from the means of lodging himſelf on its terre-plein, it is not wide enough to employ cannon in it, therefore this work can oppoſe the enemy but weakly when he has a mind to enter the glacis; and as it is much elevated, it will ſtill be eaſy to raze the parapet by the batteries erected in the country, and conſequently render it entirely uſeleſs for the defence of the covert-way.

In regard of the counterguards, it is in general to be obſerved, that they are not much in uſe, owing to the many inconveniences found in their employ. Whatever care the Mareſhal has taken to remedy it by the different conſtruction which he propoſes, there are no leſs ſubſiſting, and the height which he gives add ſtill new ones, which render this work more hurtful than advantageous to the defence, as I think I have proved above.

The manner of tracing the ditches is peculiar to this ſyſtem, and founded on that cuſtom of making them about parallel to the faces, furniſhes much ground to the enemy for his batteries on the ſalient angles, and gives him conſequently much facility to ruin the oppoſed flanks. It cannot be diſputed, that this inconvenience is met with in the common method of fortifying, particularly when the enemy can eſtabliſh his batteries on the

creſt of the glacis; for it would not be ſo if he was forced to conſtruct them on the terre-plein of the covert-way, where he would not by a great deal meet with ſo much ground: But it does not appear that the advantage which this conſtruction procures, can counterbalance the inconvenience that attends it, particularly in this ſyſtem, where the beſieger does want theſe batteries on the ſalient angle to ruin the defences of the counterguard and the ravelins, becauſe they all preſent themſelves in front, as has been already mentioned; and where, on the other hand, the ditches which are already ill defended, become ſo ſtraitened at the place where the paſſage is made, that they have not one half of the cuſtomary breadth, ſo that the filling up, commonly ſo troubleſome and long, will be done here in a very ſhort time, and without the leaſt difficulty.

ALTHOUGH this idea of taking from the enemy the ground on the ſalient angle

can be of no utility in this ſyſtem, and that on the contrary it becomes hurtful, as has been ſaid before, one might, notwithſtanding, uſe it with ſucceſs in the common method, where the batteries on the ſalient angle of the covert-way may diſcover the flanks in their whole extent; but in place of reducing the breadth of the ditch, as has been practiſed here, and which is too prejudicial to the defence, detached works before the flanked angle of the baſtions might be ordered to hide the ſight of the flanks from the enemy, without hindering thoſe ſame flanks from ſeeing the paſſage of the ditch from one end to the other, and to oppoſe it with all their batteries.

THE ravelins, the faces of which are prolonged until they meet at ſome diſtance oppoſite to the point of the baſtions, form a tenaille the ſame as the counterguard; and although the flanking angle be leſs open from it, they are no more able to

contribute reciprocally to their defence; becauſe that at a diſtance of more than 12 toiſes on the right and on the left of that angle, they have but a ſingle parapet without terre-plein whatſoever: Very likely to diſengage the faces of the baſtion, which without would find themſelves entwined in the thickneſs of the rampart of the ravelins, is the cauſe that the ditch before the ſalient angles is not defended: But if one ſhould even find means to remedy this inconvenience, it muſt be obſerved, that theſe re-entering angles are ſubject to a ſtill greater fault, which is inſeparable from them, and which increaſes in proportion to the height of the works; for here where the elevation of the earth is 30 feet above the level of the water, the cannon placed *en barbette* on their rampart cannot diſcover the ditch but from a diſtance of more than 30 toiſes from the ſaid angle, ſo that the enemy may paſs it in that extent without being ſeen or perceived, which is againſt the principles of

the art, and gives a means to form a third attack on the re-entering angle, which is ſo much the more prejudicial to the defence that it cuts the communication, and takes in back thoſe who would defend the breach, as has been mentioned in the preceding chapter.

No body can diſpute but that the Mareſhal is well founded in what he ſays concerning the cauſe of the little reſiſtance which the outworks can make; and it is ſurpriſing that in ſpite of that fault we ſhould always have confined ourſelves to the manner of unconnecting them, and by that deprive them of all communication: The changes which are propoſed cannot fail to remedy that inconvenience: But it is to be apprehended, that the idea of forming, by means of theſe ravelins, a continued incloſure, will much diminiſh the effect which one might expect from them; becauſe that the interior of it is too ſpacious, and furniſhes too much ground to the

beſieger to eſtabliſh himſelf; to which may yet be added, that the poſtern for its communication not being covered by ſome work which might at the ſame time protect the ſorties, it is infallible that the retreat can miſs to be made without confuſion; and it is impoſſible, after the troops have once been driven out, that they can re-enter it: For, to ſuppoſe with the Mareſhal, that in caſe they were repulſed, they had but to retire to the foot of the body of the place, where they might maintain themſelves without danger of being forced to quit the dry ditch; this will not appear ſo ſure when we conſider, that they may be attacked in front and flank, as has been already mentioned.

FROM theſe remarks we think to be able to draw the concluſion, that the ravelins will anſwer better at the end, if they formed detached works, and were conſtructed in ſuch a manner as to be able to flank one another, and if they communicated by the

means of a rampart leſs raiſed, which might procure them at the ſame time a low defence. It is true, that this diſpoſition would not entirely cover the body of the place: But beſides having proved that the inconvenience of ſuch an ordonnance exceeds the advantages, I have likewiſe ſhown in the preceding chapter, that the ravelins, although they form a continued incloſure, cover it no better, and the enemy may diſmount the defences of the baſtions, without it being poſſible to prevent him.

WHAT has been propoſed concerning the changes of the ravelins, would anſwer ſtill better if the baſtions were at the uſual diſtance from one another; that would procure the means to place theſe works before the flanks, as well as before the curtains, where one might at the ſame time conſtruct a tenaille to cover the gate of communication: By this we would obtain the advantage of covering the flanked angle

of the baſtions, and to keep the enemy at a diſtance from it; to defend the ditch with the cannon and muſketry from ſeveral places at the ſame time; that of ſeeing the breach of the outworks in reverſe; to ſecure the retreat of the ſorties; and to give them means to return to the charge as often as it ſhould be thought proper.

THE polygon being by this ſyſtem beyond one half ſmaller than the common, all the lines of the body of the place are out of proportion, and the baſtions ſo much ſtraitened that no great ſervices can be expected from them: This inconvenience is yet a continuation of the manner to cover the body of the place; for if we were to allow the common ſize to the polygon, the faces of the ravelins would become double the length, and their capaciouſneſs four times greater, which would furniſh an immenſe deal of ground to the enemy, and require a greater number of troops for its defence than we can allow.

THE cavalier is of an invention no leſs new than the other parts of this fortification: Without contributing any thing to the defence, as I have already mentioned, it is conſtructed only to place the ſouterrains in, which ſerve as lodgements to the garriſon, and to cover them from the fire of the enemy during the ſiege, becauſe that it would not be poſſible to reſiſt without them in a place which has not 100 toiſes of diameter, ſuch as the interior of this place: But it is to be obſerved, that it would not have been neceſſary to raiſe it to that height, if it had not been for the reaſons alledged at the end of the preceding chapter, and which derive from the ſame principle as ſeveral other inconveniences remarked in this ſyſtem.

THIS is not the place to examine whether this method of lodging the garriſon will not be very prejudicial to the health of the troops, who ſhall have no other dwelling than ſouterains, damp and ill aired,

even if they were conſtructed of maſonry: There is all the reaſon imaginable to fear it, and we cannot doubt it when we conſider that the cavalier, the height of which has one-tenth of the whole interior extent of the place, forms a kind of tunning-diſh, where the air can renew itſelf but with difficulty, and not by far ſo much as is required to prevent the corruption which 300 or 400 men ſqueezed together muſt inevitably produce, and which the exhalations from the wet ditches ſtill augment.

THESE reflections do not altogether agree with the ſentiments of the Mareſhal. As the novelty of the ſubject may be the reaſon that his ideas may not always have been well underſtood, I ſubmit to the judgment of the connoiſeurs, and ſhall think myſelf happy if theſe remarks, ſuch as they are, can give riſe to ulterior reſearches on a matter that intereſts the preſervation of the ſtate, and the ſafety of the people.

THE END.

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OF the changes which this obſervation would produce in the method of fortifying.

OF the advantages which would reſult for the defence.

BY

CHARLES THEODORE D'ASTI.

TO THE PUBLIC.

THE principles of the attack and defence of places have ſuch a connection, that the diſcoveries made in the one of theſe ſciences have always furniſhed reſources to the other either to ſtop the impetuoſity of a ſuperior ſtrength, or to overcome the obſtacles which induſtry produces. It is thus that they have worked in turn to their reciprocal advancement, although things have not on that account remained in a juſt equality.

DEFENCE, ſubordinated to attack by its nature, has always been reduced to ſeek ſome means to oppoſe itſelf to the efforts of the multitude, to remedy the inconveniences of an incloſed ground, and to ſupply its weakneſs by the aſſiſtance of art. The great number of ideas which the ſtudy of ſo complicated a matter has produ-

ceed, and which experience has rectified, hath fixed the principles of fortification, and determined the manner of putting them in practice; but whatever progreſs the art of fortifying may have made, the attack has always found means to puzzle the defence in its operations, and turn its own arms againſt itſelf. We may eaſily convince ourſelves of the truth of this, when we conſider how much the beſieged are cramped and prevented in the defence of their works, and how much theſe ſame works are prejudicial to them when they fall into the hands of the enemy. This induces me to hope, that reflections which hint on theſe two points, however little proportional they be to the importance of the ſubject, which deſerves the moſt ſerious attention of thoſe who apply themſelves to perfect the ſyſtem of defence, will not be deemed miſplaced.

THE different degrees of perfection in ſciences depend on the accuracy of their

principles, and of the knowledge more or leſs expreſſive of the properties which reſult from them; and the aim of their ſtudy ought to be, to ſtate the firſt, to augment the number of the laſt, and to make new combinations with their aſſiſtance. This is the firſt quality of the inquiries; the ſecond conſiſts in the choice of the means, to apply theory to practice. If we find ourſelves deceived in this, as it may eaſily happen when engaged in a new way, ulterior reflection ſupported by experience will ſoon diſcover the error, and rectify the ideas that have occaſioned it. It is by following this method that the ſciences have made ſome progreſs, and it is by ſuch means that they will arrive to their perfection, preſerved to the ſucceſſion of time.